Towards an Ontological Foundation of Service Dominant Logic

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Abstract. The development of service science requires an appropriate theoretical foundation; S-D logic has been proposed as a candidate. Nevertheless, the application of the principles of S-D logic in service science suffers from inconsistencies and misunderstanding. In this paper we provide an ontological representation of S-D logic in order to clarify its key concepts and analyze their relationships. The paper contributes in the establishment of S-D logic as the foundational theory of service science, the resolution of inconsistencies and misunderstandings, the improved understanding of the concepts of S-D logic and the improved communication of experts from diverse areas in the multidisciplinary field of service science.

Keywords: service, value co-creation, service system, service science, service dominant (S-D) logic.

1 Introduction

The development of a service-based economy has stimulated a great interest in the study of service. Once a marginal research domain for the study of the 'exception' [28] (i.e. goods with some odd characteristics, such as intangibility, heterogeneity, inseparability and perishability), the study of service grew extensively in importance and "service science" was proposed [6] as a new, multidisciplinary field with the purpose of providing a deep understanding of how to innovate in services. Service science aims to integrate a variety of research areas in business, engineering, computer sciences and other related fields by focusing on service as the central phenomenon of research interest and envisages the discovery of the underlying logic of service systems and the establishment of a common language and shared research frameworks [18].

Spohrer and Maglio [19, 12] single out service systems and value co-creation as the two most fundamental concepts of service science, with the one referring to the basic entities in service-based environments and the other to the basic action that takes place in the interaction between service systems; they add that "[v]alue cocreation is the primary object of study in service systems" and they explain that "service science is the study of value-cocreation phenomena".

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However, the concepts of value, value creation and value co-creation, even though extremely significant, still remain rather unclear and vague in the literature. For example, Spohrer and Maglio [19] believe that value is necessarily co-created, as a result of interactions of multiple service systems. But does every interaction result in value co-creation? Does value co-creation happen merely because of the interaction between entities? And how could one proceed with the study, analysis and modeling of value co-creation in service systems? The vagueness and the complexity of value co-creation result in a limited understanding of value co-creation processes in general and a lack of methods for the analysis of value co-creation in service systems.

Service-Dominant (S-D) logic, a conceptual business framework that is based on an 'alternative' concept of service, has been recognized and proposed as "one of the corner stones of service science" [13] and "the philosophical foundation of service science … [providing] the right perspective, vocabulary and assumptions on which to build a theory of service systems, their configurations, and their modes of interaction" [12]. Nevertheless, Maglio, Kieliszewski and Spohrer [13] admit that service science was inconsistent in applying the principles of S-D logic ("[b]ut we are coming around"). This inconsistency was pointed out by Vargo and Akaka [26] and Vargo, Lusch and Akaka [28], who relate it to misunderstandings or misconstrues in several fundamental principles of S-D logic related to the meaning of service in general, the concept of "service as the basis of all exchanges" and the nature of value co-creation among service systems.

Why service science hasn't managed to adopt extensively and successfully the principles of S-D logic? Alter [3] suggests that service science and S-D logic attempt to explicate fundamental ideas about service, but they do it at different levels of analysis and for different purposes; S-D logic focuses on business, whereas service science aims to help IT professionals and engineers to understand, analyze, implement and improve service systems. Ferrario and Guarino [8] point out several weaknesses in current research in service science, including shortcomings in the definition of service and other key concepts and a lack of alignment between business and IT approaches. In a similar vein, Vargo, Lusch and Akaka [28] suggest that service science has an inherent engineering nature and production orientation, which tends to be focused on design specifications and operational processes. Vargo, Lusch and their colleagues are repeatedly arguing for the need of an S-D logic lexicon [22, 23, 27, 28], because many words and concepts carry specific connotations that are often incompatible with the conceptualizations of S-D logic and, consequently, can lead to misunderstandings.

The purpose of such a lexicon would be to provide the basic terms and conceptualizations of S-D logic and interpret originally their meaning. In this paper we move beyond the need for a lexicon and attempt to develop an ontological foundation of S-D logic, which not only identifies and explains the key concepts, but most importantly, analyses their relationships as well, providing this way a means for the clarification of the concepts and relationships and the deeper understanding of S-D logic. We prefer to say 'ontological foundation', rather than 'conceptual model' or 'ontology', because, on the one hand, S-D logic is basically a conceptual model in itself and, on the other hand, our work targets at a preliminary stage of ontological development, lacking the rigour of formal ontologies.

The proposed ontological foundation of S-D logic is based on concepts that derive basically from the 10 foundational premises of S-D logic [21, 23], the discussion on the need for a lexicon of S-D logic [22, 23, 26, 27] and the literature of S-D logic, in general. It is represented here as a class diagram, which is a familiar and friendly way of knowledge representation, especially for scientists and practitioners in computer science and engineering.

An ontological foundation of S-D logic can support in multiple ways the development of service science. An ontology provides a common framework of concepts and relations in order to conceptualize and describe a specific domain of interest. The most popular definitions of ontology are "formal and explicit specification of a shared conceptualization" and "classification of the existing concepts" [9]. Both these definition have significant implications for the development of service science. First of all, the development of a "shared conceptualization" is a key requirement in itself [12], because it can accommodate and support multidisciplinarity. In addition, it is necessary for the value co-creation between different service system, as it can remove the possible misunderstandings and misinterpretations. The "classification of concepts" applies to the need for the development of a lexicon for S-D logic, which was suggested by Vargo and Lusch [22] as a major challenge in the advancement of S-D logic.

The purpose of this paper is to contribute in the development of service science, the establishment of S-D logic as the foundational theory of service science, the improved understanding of the concepts of service and value co-creation and the improved communication of experts from different areas in the multidisciplinary field of service science.

The remainder of this paper is organized as follows: in section 2 we provide an overview of the state of the art with regard to approaches to service knowledge representation and service modeling. In section we 3 make a brief overview of S-D logic and analyse its key concepts. In section 4 we develop an ontological representation of S-D logic and analyse its content. The paper concludes with the results of the study and directions for future research.

2 Analysis of the State of the Art

In this section we provide a critical review of the state of the art on the conceptual analysis of service systems. We focus on approaches that take into consideration the business aspects of services and service systems, rather than approaches that stay simply with technological aspects and concerns. Note that, while there are numerous technical specifications to describe computerized services, including Web services and SOA, the research on the business aspects of service systems is rather limited. We distinguish two basic research streams in this particular part of the literature: the first one foregrounds the development of conceptual foundations of service systems; the second one aims at the business modeling of service systems.

2.1 Conceptual Approaches

Ferrario and Guarino [8] provide a general ontological foundation for service systems that emphasizes the business aspects and the social role of services. Services are

considered as complex notions of commitments and activities with spatiotemporal characteristics that are related to actual circumstances and experiences. The proposed service ontology is informal and includes the concepts of service commitment, service content, service roles (i.e. service trustee, service producer and service customer), service process, service availability, service delivery, service acquisition, triggering event and (reciprocal) service value exchange.

Stanicek and Winkler [20] provide a conceptual meta-model for service systems. They use the definition of service system provided in service science [12] and enhance it with contextual and temporal aspects. Given the contextual character of services, they suggest that it is better to focus on relationships, rather than on objects. They notice three core elements in any service system: a Service Provider, a Service Consumer/Client and a Target. Hocova and Stanicek [11] propose the concepts of "prime service system", that creates benefit for the client, and "dual service system", as a collaborative service system that consists of two prime service systems and creates benefit for both systems.

Alter [2] proposed the Service Value Chain Framework (SVCF) as a business-oriented framework that introduces ideas related on service co-production. The framework is based on nine elements, four of which constitute the work system (processes and activities, participants, information, and technologies) and the rest five provide a basic understanding of the situation (products and services, customers, the organizational environment, infrastructure and strategies).

O'Sullivan [14] proposes a taxonomy of the non-functional properties ("constrains") of services under the premise that service is not simply a function, but "a function performed on customer's behalf at a cost" expressed both in monetary terms and with other types of restrictions. The categories of the non-functional properties of services include: temporal and locative availability, payment, price, obligations, rights, quality, security, trust, penalties and discounts.

2.2 Business Modeling Approaches

Poels [15] proposed the "Resource-Service-System model" for the study of service exchanges between service systems. Based on the conceptual background of REA and concepts from service science (e.g. the definition of service system) and S-D Logic (e.g. value co-creation, operant and operand resources, etc.), service is considered as a process and service systems are viewed as participating in the co-creation of value, by playing the roles of resource provider and resource integrator. The author provides additional model views referring to the reciprocal nature of service interactions, the composite (nested) structure of the service systems, the accountability of service agents and the articulation of service processes.

REA and other approaches from the business modeling literature are used as a basement by other authors, as well. Weigand et al. [29] proposed a Unified Service Ontology and a Service Layer Architecture, regarding service as a type of resource and unifying conceptually business services and software services. Andersson et al. [4] developed a Reference Ontology of Business Models which includes the concepts of Actors, Resources, Events (categorized in transfer and convert events related to production and consumption), Processes, Commitments, Contracts, Agreements, Value Activity and Value Proposition.

Serviguration [5] emphasizes the component-based structure of services: service is seen as a bundle of benefits that satisfies customer needs. It includes two perspectives, the service value perspective, referring to the customer, and the service offering perspective, referring to the provider. E3-service [7] builds on Serviguration and extends it by emphasizing on the customer perspective and on service compositions in "value constellations".

Sorathia, Van Sinderen and Pires [17] propose a process-based framework for service management; the key concept is the Service Process, which is associated to Operations, Roles, Outcomes and Work Products. Scheithauer [16] provides a reference model that classifies service descriptions and outline two meta-models for the conceptual modelling of services (the Business Service Meta-model and the Value Properties Meta-model).

2.3 Critique on the State of the Art

There is a remarkable variety in the origin of the concept of service, as well as in other basic concepts. Because of their business concern, many approaches receive input from the business management or the economics literature for the definition of service, service systems and other critical concepts (e.g. value, customer, need, etc.). Some approaches [2, 8, 15, 17, 20, 29] refer to service science and only a few [2, 15] refer to S-D logic, in particular as current research trends, but without incorporating them organically in the proposed models. Only Alter [2], Poels [15] and Stanicek [20] base their work on input from service science and/ or S-D logic.

We distinguish three main approaches in the definition of the concept of service: service as an event, service as a process and service as a resource. The example of Poels [15], who integrates elements of all these approaches, is indicative of the complexity of the service domain: he considers service as a process, defines a service system as an aggregation of resources and comments on the similarity between the concepts of economic event in REA and service in S-D Logic. The concept of the service as an event (in fact, as triggered by an event) is developed in Ferrario and Guarino [8] and adds contextual dimensions to service. Service as a process is a common approach in the literature [2, 14, 15, 17], which complies apparently with the notion of service in S-D logic; however, S-D logic considers service as a value co-creation process, rather than simply as a business or production process. Service is viewed as a resource in Weigand et al. [29] and Andersson et al. [4].

Only a few approaches make a step beyond business concerns to include the needs of the customer. Note that the inclusion of the role of the customer or of some customer-related terms (e.g. needs) is not a necessary condition to characterize an approach as customer-oriented, if otherwise the perspective still remains with business concerns and aims at business objectives. For example, Serviguration [5] provides a methodology for formalizing customer needs and service offerings in business networks and includes the perspectives of the customer, but the match making process takes for granted suppliers' offers and, hence, the purpose is to fit customer needs into suppliers' offers (demand).

Co-production and value co-creation is examined in Alter [2] and in Hocova and Stanicek [11]. Co-production is a basic assumption in SVCF [2], where the Service Responsibility Table is used for describing the activities and responsibilities of both

the provider and the customer (this tool is also used by Ferrario and Guarrino [8]). The collaboration in "dual service systems", as described in Hocova and Stanicek [11], imply value co-creation, because the "target" is the same for both service systems.

One could argue that some other works make some implicit reference to customer participation, in general, and to value co-creation. For example, the concept of reciprocity of value, included in Poels [15], Weigand et al. [29] and Andersson et al. [4], implies that the customer is also creating value; however, here emphasis is put to the value created by the customer and returned to the provider, rather than the value that is co-created with and by the customer for his own benefit. Ferrario and Guarino [5] refer to the role of the customer with the concepts of service acquisition, negotiation and invocation and service value exchange; however, such customer's activity fits better to the G-D logic, rather than the S-D logic.

3 Overview of S-D Logic

S-D logic considers service as the process of using one's competences and resources for the benefit of another party, distinguishes between direct and indirect (i.e. through goods) service provision, emphasizes on value creation, focuses on knowledge and skills as resources of value and recognizes the primary role of the customer in the value creation process. The spirit of S-D logic is reflected on ten foundational premises (FPs) [21, 22, 23]. One could argue that FP1 to FP5 refer roughly to the notion of service, while FP6 to FP10 refer to the notion of value and value co-creation. A brief explanation of the foundational premises of S-D logic, along with some key ideas, follows.

The core concept in S-D logic is the 'service' (in singular). The basic definition of service is "the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself" [21]. Hence, service includes also the various activities of the beneficiary to enhance or improve the benefit received from other entities, a process that could be described in general as 'self-service'.

Goods (i.e. products and services) are involved indirectly in the process of service provision, as conveyors and distribution mechanisms of the competence of the providers (FP3). The process of providing service for another party in order to obtain reciprocal service (FP1) is the core of all economic exchanges (FP5), even though indirect exchanges, that is through goods and with the use of money, mask this service-based notion of exchange (FP2). In S-D logic 'service is exchanged for service'. The primary meaning is that, when people participate in exchanges, they do not exchange in fact products or services, but their special knowledge and skills. From a certain aspect, the service that the provider takes back is the feedback of the customer (direct or indirect, through the consumption choices) and the opportunity of learning from the interaction with the customer.

Service is based on the application and use of resources. S-D logic distinguishes between operant and operand resources. The creation of value is based on operant resources (FP4), such as knowledge, skills or competencies, that act upon other resources to create value. Operand resources, on the other hand, such as natural

resources, goods and money, require operant resources to provide value. The customer himself, with his intentions, knowledge and skills, is one of the most important operant resources in S-D logic.

Value is always co-created (FP6) with the collaboration between the customer and other economic and social actors (e.g. peers), who interact to provide their resources in value creation networks of different levels of aggregation. The role of the customer in the co-creation of value is fundamental and takes place by providing his resources (e.g. knowledge and skills, especially in co-production settings), integrating resources or simply providing the context for the creation of value. For this, Vargo and Lusch [23] suggest that value co-creation is a positive condition ("neither normative nor optional" [24]). Accordingly, besides business organizations, which integrate and transform micro-specialized competences into complex value propositions with market potential, customers function as resource integrators as well; all economic and social actors are resource integrators (FP9) and, thus, the producer–consumer distinction is eliminated. To make it clearer, Lusch and Vargo [22] distinguish between value co-creation and co-production, with the latter being defined as a way of value co-creation, in which the customer participates directly in the firm's production process somehow.

Firms cannot create and deliver value by themselves, but they can only make value propositions (FP7) and provide service as input to the value co-creation process; if the proposition is accepted, value is co-created in concert with the customer and in the customer's context. In other words, firms support the customers in their value creating processes. Value creation, therefore, is inherently customer oriented and relational (FP8).

Since resources, in general, do not have intrinsic value, they acquire value when they are used ('value in use'). The value is not created until the customer, as beneficiary of the service, integrates and applies the resources of the provider(s) with other propietary resources that exist in his context. Thus, value is always uniquely and phenomenological determined by the beneficiary (FP10). Accordingly, Vargo [25] uses the term 'value-in-context' to describe the value that is uniquely co-created at a given place and time and is phenomenologically determined, based on existing circumstances, resources and capabilities.

The concept of 'service ecosystem' was added in the literature recently, to describe a complex series of mutual service-providing and value-creating relationships and to capture the dynamic, self-adapting and relational nature of value creation [25]. In service-ecosystems, all actors have the dual role of providers and customers/ beneficiaries. The service ecosystem extends in effect the concept of 'business ecosystem' by adding the customer's ecosystem. Hence, in service ecosystems business firms and individuals participate to co-create value for themselves and for the others.

4 An Ontological Representation of S-D Logic

In this section we present an ontological model of the key concepts and relationships of S-D logic. The proposed model is different in several aspects from other similar efforts in the literature of service modeling. The key difference is that we do not aim

to develop a new conceptual framework for service systems, service exchanges or service management, but we limit our scope to the ontological representation of S-D logic. For this reason, we stay with the concepts of S-D logic, without attempting to combine and enrich them with additional concepts from service science or business modeling frameworks. If we did it, it would introduce an implicit assumption that S-D logic does not provide the right or a complete theoretical framework for service science. On the contrary, a major problem in service science is the assimilation of the concepts of S-D logic and the resolution of misunderstandings and contradictory knowledge. Our effort aims at contributing in the resolution of this problem.

4.1 The Ontological Model

The ontological model of S-D logic involves the following concepts: Actor (as a generalization of Customer and Provider), Service (as a generalization of Direct Service and Indirect Service), Value Co-creation (as a generalization of Co-production Integration and Customisation), Value (as a generalization of Knowledge and Experience – and other concepts possibly), Resource (as a generalization of Operant Resource and Operand Resource), Context (as a generalization of Situational Context and Idiosyncratic Context). Note that in most cases the categorization of the concepts is indicative and not complete (e.g. in Value or in Value Co-creation). The ontological model of S-D logic is depicted in Fig. 1 in the form of a class diagram. A brief explanation of each concept and relationship of the model follows.

Actor. It is a general term used to address to the entities that participate in the value co-creation process. We consider that such a general and neutral term can accommodate the different roles of the participants in value co-creation processes in service ecosystems. Besides, the term 'actor' is widely used in the S-D logic literature to describe the transcendental role of the economic entities as providers and customers/ beneficiaries of service. In FP9, in particular, it is declared that "[A]ll economic and social actors are resource integrators". In this phrase, 'actor' refers to the subject, while 'resource integrators' is a characterization of their behaviour. Any other term, such as resource integrator, value configurator, value creator, etc., that may be used in the literature to describe the functions of entities focuses on some aspects of their behaviour and, hence, they are not appropriate candidates. In other words, all actors may integrate resources, but it is not the single kind of their activity (or at least the key activity) that can determine their existence. Different kinds of actors can participate in the service ecosystem, such as business firms, individuals, social groups, intermediaries, governmental agencies, etc. This categorization, not included in Figure 1 for reasons of economy of space, enriches the concept of Actor by providing information on his special attributes.

Customer and Provider. They are the two key roles played by Actors in value co-creation processes. The Provider is the Actor that provides Service for the benefit of the Customer, while the Customer is the beneficiary Actor that receives the Service provided. As value co-creator, the Customer may receive and integrate Service from many Providers and supplements them with proprietary resources. We prefer to include the Customer and the Provider as separate entities in the model, even though they reflect basically the different roles of the Actor, because it allows relating

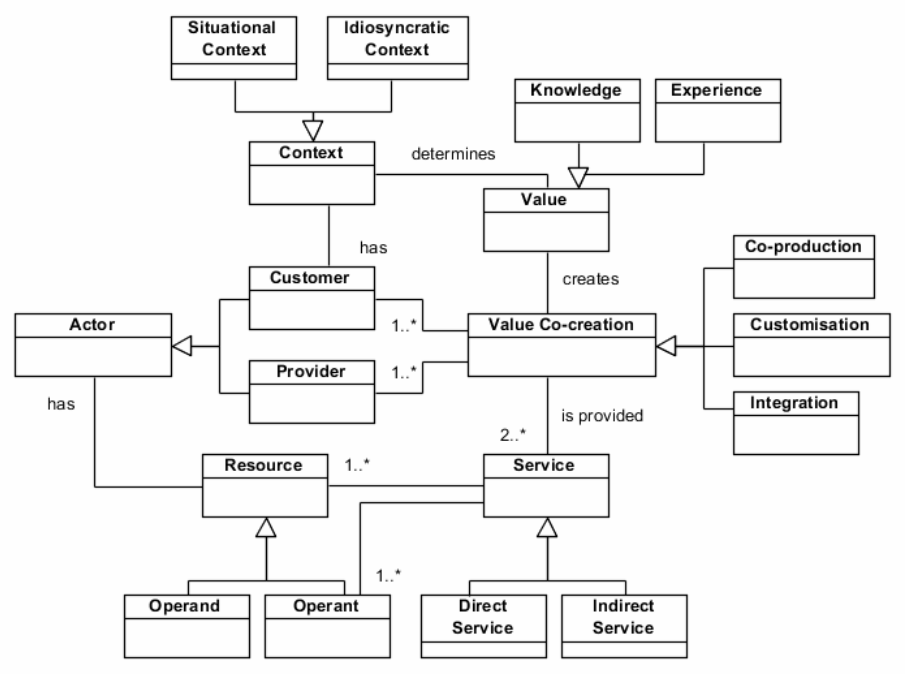

Fig. 1. An ontological model of S-D logic

specific phenomena to each particular role (e.g. in FP 10, Value is manifested in the Context of the Customer). If we eliminated this categorization, two Actors at least would participate in Value Co-Creation, which is in accordance with S-D logic.

Resource, Operant Resource and Operand Resource. Resource refers to any kind of input used by Actors in value co-creation processes, either physical/ tangible or spiritual/ intangible. In S-D logic, Resource is classified in Operant and Operand Resource; the former are those that are able to act upon others to create value (e.g. knowledge and skills), while the latter need to be acted upon (e.g. goods).

Service. It is the application of specialized competences (knowledge and skills) for the benefit of another entity or the entity itself; hence, Service is a process of applying Resources. Operant resources participate always in service processes because they have the power to transform other resources (operant and operand) to produce effect. We depict it in the model with an association named 'resourcing' between Service and Resource and an association between Service and Operant Resource. 'Recourcing' [27] refers to the activity of rendering resources into a specific benefit, which describes the way that value creation occurs.

Direct Service and Indirect Service. Service does not refer to (the physical attributes of) a process output, but it is a transcendental term for the activity of doing something for the interest or benefit of somebody else. Hence, service is a superordinate concept that includes both tangible and intangible goods ('services'). Service is what is always exchanged, either in Direct Service interactions (services) or

in Indirect Service interactions, through tangible goods (products). Self-service for instance, that is the application of resources by the beneficiary entity for itself, can be considered a special kind of Direct Service (not depicted in the Figure 1).

Value Co-creation. It is a key concept in S-D logic that refers to the service-based collaboration of at least one Provider, who provides Service, and at least one Customer, who integrates and complements it with proprietary Service, for the co-creation of value. The cardinality of the association between Provider and Customer on the one hand and Value Co-creation on the other hand includes both dyadic and network relationships. The concept of the service ecosystem is accommodated here as well, as it is allowed the participation of multiple Customers, each one with his own value ecosystem.

Co-production, Customisation and Integration. Value Co-creation is a general concept that can be actualized in many different ways. Co-Production, Integration and Customization are three of the ways that are described generally in the S-D logic literature and are included in the model as subcategories of Value Co-Creation. Co-production refers to the direct participation of the Customer in the processes of the Provider. Customisation refers to the activities of the Provider to adjust the Service to the preferences of the customer, after receiving some relevant input. Integration refers to the basic function of the Customer for combining Service from different Providers, and potentially adding proprietary Service as well, for the creation of value. Additional types of Value Co-creation may exist.

Value. It is the output of the Value Co-creation process. In S-D logic, value is related to the customer (e.g. in FP10); for this, the concept of Value is related to the (Customer's) Context, with the exact content of value to be determined 'contextually and idiosyncratically' by the customer. The concept 'value-in-context' was introduced recently in the literature of S-D logic, in order to enhance the concept of 'value-in-use' with contextual dimensions. Value affects also the Provider, as a result of FP1 ("service is the fundamental basis of exchange"), namely that 'service is exchanged for service'. This premise introduces a reciprocal relationship in value co-creation, which takes the form of feedback (direct and indirect, through market success and monetary measures).

Knowledge and Experience. They are two basic kinds of Value that is co-created between the Customer and the Provider. Knowledge refers to learning opportunities and the improvement of the Resources. Experience is a basic way that the Customer perceives Value. Additional types of Value may exist.

Context, Situational Context and Idiosyncratic Context. The term 'context' is introduced in S-D logic with PF10, referring to "the context of the beneficiary". The Context refers to the general conditions that exist with regard to spatial, temporal, social and relational dimensions, as well as to the personal needs and traits of the Customer. Situational Context and Idiosyncratic Context are two types of Context; the former refers to the general environment surrounding the Customer, with its physical and social dimensions; the latter refers to the subjective situation of each Customer, with concern to his personal traits, psychological or mental situation, needs and experiences.

4.2 Discussion

The central concept in the model, that interconnects most of the key entities (i.e. Actors, Service and Value), is the Value Co-creation. It is interesting to note that, even if we exclude the concept of Service from the model, its explanatory power remains almost intact, other than cancelling the types of Service (Direct Service and Indirect Service). The Service in the model (Fig. 1) is an intermediating concept between Resource and Value Co-creation, meaning that the application of Resources, namely Service, is used for the Value Co-Creation. With the potential exclusion of Service, Value Co-creation becomes the result of the direct application of Resources from the Actors, which is compliant with S-D logic. This case is depicted in Fig. 2. Again, in the Value Co-Creation process participate at least one Customer and at least one Provider that provide their Resources, of which at least one must be Operant Resource (e.g. the knowledge or the experience of the Customer for the integration and use of Resources).

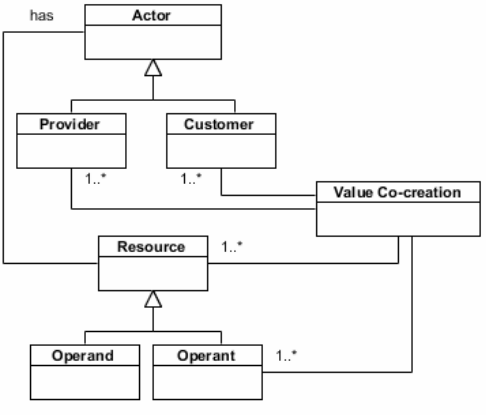

Fig. 2. An ontological model of S-D logic without the concept of Service

The point of this argument is to not to lower the importance of the notion of service, but to indicate that the key concept in service interactions is value co-creation. This argument is in accordance with service science, which regards value co-creation as the core phenomenon of service systems. Note that this argumentation does not derive theoretically, but logically, as a result of the ontological representation of S-D logic.

From a first glance, one can see that some important and much discussed notions and ideas in S-D logic are not included in the model. With regard to the foundational premises of S-D logic, the exchange (FP1 and FP2), the competitive advantage (FP4) and the value proposition (FP7) are not included. With regard to the possible entries to the lexicon, the notions of solution, dialogue, reciprocity/ interactivity, value-in-use, value-creation network and service ecosystem are mot included either. Next we provide some explanation for this.

The notion of exchange is basic in S-D logic, as service is considered as the fundamental basis of exchange (FP1) and it is assumed to be exchanged for (other) service. However, in the ontological model of S-D logic, exchange is found to be a competing concept to Value Co-creation, as they both have a similar position in the model and they cannot be both accommodated in it. For example, if we replace Value Co-creation with Exchange, the rest of the model in Fig. 1 would be the same, but its interpertation would be distorted. The exclusion of the exchange from the ontological model does not mean that exchanges as economic phenomena are not important or are not present in S-D logic, but it suggests that, from a logical point of view, the concept of exchange is implicitly included in the Value Co-creation process, with the meaning of contribution of service and resources. We think that 'contribution' also relates to reciprocity and fits better to S-D logic, especially as the concept of exchange has a strong inclination towards G-D logic (e.g. value-in-exchange) and dual relationships.

An option to include both Value Co-creation and Exchange in the model is presented in Fig.3. It is clear that here the spirit of S-D logic is distorted. In this case, Customers and Providers Exchange Service and it is this Exchange process that leads to Value Co-creation (which provides some types of Value, etc.). Another option would be to sacrifice Value Co-creation, by replacing it in Fig. 3 with Value. In this case, the meaning would be that Customers and Providers Exchange Service and through it they create Value.

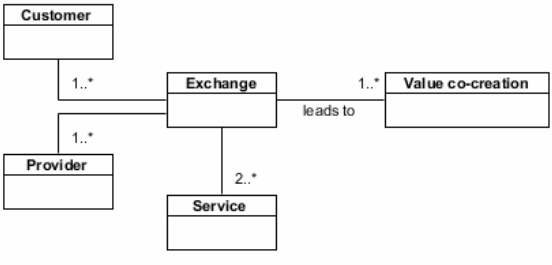

Fig. 3. An exchanged-based model of S-D logic

'Value proposition' has the meaning that the provider cannot create value for the customer by himself, but can only make a value proposition, of which the customer can take advantage in order to co-create value. The notion of value proposition cannot be accommodated in the model, because the concept of Service in Fig. 1 is related to the activities of the Customer as well (i.e. the Customer provides also his own Resource and Service in the Value Co-creation process). A sub-optimal option would be to define value proposition as an associative concept between Service and Value Co-creation – and relate it also to Value. However, we think that it would increase only the complexity of the model, without adding significantly to its explanatory power.

The notion of 'competitive advantage' is implicitly included in the model through the concept of Knowledge as a type of Value (of course, it is different from the conventional concept of competitive advantage in business strategy). Again, the ontological representation reveals that some notions of S-D logic do not fit together in

an obvious and direct way and they can provoke misunderstandings. In S-D logic we have, on the one hand, value that is determined uniquely and phenomenologically by the customer and, on the other hand, value through a learning process for the provider. In Fig.1 Value is related only to the Customer through Context. Another option would be to relate Value to the Actor, in general, through Context – but it would add contextual dimensions to the value for the Provider, as well.

The notion of 'solution' is implied in the model as the result of the Value Co-creation process (i.e. when it is successfully performed, it will provide a solution for the Customer). The same interpretation holds for 'dialogue', 'reciprocity' and 'interactivity', as they are all conceptual elements related to the Value Co-Creation process. 'Value-in use' is related to 'value-in-context' [26] and it derives from the association between Value and (Customer's) Context. The notions of 'value-creation network' and 'service ecosystem' refer to the whole S-D logic model.

5 Conclusions

An ontological representation of S-D logic can provide certain benefits for the establishment of S-D logic as the foundational theory of service science. First of all, it can be used for the examination of the completeness of S-D logic from a logical point of view. In the previous section we indicated some cases that the ontological (logical) analysis can provide insights (e.g. the relative importance of Service and Value Co-creation), clarify concepts (e.g. value proposition as a business-oriented concept or competitive advantage as a learning opportunity through knowledge feedback) or single out inconsistencies (e.g. the contradictory relationship between value co-creation and exchange). It is a matter of theoretical research and argumentation to decide on the correctness and the significance of these suggestions that derive from the logical analysis. This way, the ontological analysis can support not only the interpretation of a theoretical framework, but its improvement as well. The ontological representation of S-D logic can provide a basis for transdisciplinary communication, especially with scientists and practitioners from the engineering and computing fields. In addition, it could provide the necessary vocabulary and modeling constructs for the development of information systems [10].

Directions for future research include a variety of options. A key requirement is the elaboration of the foundational ontology of S-D logic with additional concepts, relationships and rules, for example with regard to the types and respective processes of value co-creation, the types of value for the customer and the provider, the contextual parameters, etc. The development of partial views (e.g. a provider's view, a customer's view, a business intermediary view, etc.) would be another research option, which would cast light on specific aspects that are not shown in details in the overall model. The development of particular S-D logic models for specific business cases would provide detailed and practical knowledge on service interactions and value co-creation processes. Another opportunity is to relate, compare and finally merge the foundational ontology of S-D logic with concepts from the literature of service science, in order to provide a related ontology of service science. The formalisation of the ontological model of S-D logic would allow for automated reasoning in value co-creation processes; however, such a formalisation should

normally take place with regard to particular business models, because automated reasoning should be based on specific and detailed information about service interactions.

References

1. Akkermans, H., Baida, Z., Gordijn, J.: Value Webs: Ontology-Based Bundling of Real-World Services. IEEE Intelligent Systems 19(44), 23–32 (2004)
2. Alter, S.: Service system fundamentals: Work system, value chain, and life cycle. IBM Systems Journal 47(1), 71–85 (2008)
3. Alter, S.: Service Systems and Service-Dominant Logic: Partners or Distant Cousins? (2008), http://web.me.com/mstevenalter/StevenAlter.com/
4. Andersson, B., Bergholtz, M., Edirisuriya, A., Ilayperuma, T., Johannesson, P., Gordijn, J., Grégoire, B., Schmitt, M., Martinez, F.H., Abels, S., Hahn, A., Wangler, B., Weigand, H.: Towards a Reference Ontology for Business Models. In: Embley, D.W., Olivé, A., Ram, S. (eds.) ER 2006. LNCS, vol. 4215, pp. 482–496. Springer, Heidelberg (2006)
5. Baida, Z.: Software-aided Service Bundling - Intelligent Methods & Tools for Graphical Service Modeling. PhD thesis, Vrije Universiteit, Amsterdam, NL (2006)
6. Chesbrough, H., Spohrer, J.: A research manifesto for services sciences. Communications of the ACM 49(7), 35–40 (2006)
7. De Kinderen, S., Gordijn, J.: E3service: An ontological approach for deriving multi-supplier IT-service bundles from consumer needs. In: Proceedings of the 41st Annual Hawaii International Conference on System Sciences. IEEE CS, Los Alamitos (2008)
8. Ferrario, R., Guarino, N.: Towards an Ontological Foundation for Services Science. In: Domingue, J., Fensel, D., Traverso, P. (eds.) FIS 2008. LNCS, vol. 5468, pp. 152–169. Springer, Heidelberg (2009)
9. Gruninger, M., Lee, J.: Ontology: Applications and Design. Communication of the ACM 45(2), 39–41 (2002)
10. Guarino, N.: Formal Ontology and Information Systems. In: Proceedings of 1st International Conference on Formal Ontologies in Information Systems, Trento, Italy, pp. 3–15. IOS Press, Amsterdam (1998)
11. Hocová, P., Staníček, Z.: On Service Systems – By Definition of Elementary Concepts towards the Sound Theory of Service Science. In: Morin, J.-H., Ralyté, J., Snene, M. (eds.) IESS 2010. LNBIP, vol. 53, pp. 179–191. Springer, Heidelberg (2010)
12. Maglio, P.P., Kieliszewski, C.A., Spohrer, J.: Introduction: Why a Handbook? In: Handbook of Service Science. Service Science: Research and Innovations in the Service Economy, pp. 1–8. Springer, Heidelberg (2010)
13. Maglio, P., Spohrer, J.: Fundamentals of service science. J. of the Academic Marketing Science 36(1), 18–20 (2008)
14. O'Sullivan, J.: Towards a Precise Understanding of Service Properties. PhD thesis, Queensland University of Technology (2006)
15. Poels, G.: A Conceptual Model of Service Exchange in Service-Dominant Logic. In: Morin, J.-H., Ralyté, J., Snene, M. (eds.) IESS 2010. LNBIP, vol. 53, pp. 224–238. Springer, Heidelberg (2010)
16. Scheithauer, G.: Business Service Description Methodology for Service Ecosystems. In: Proceedings of the 16th CAISE-DC 2009, Amsterdam, The Netherlands, June 9-10 (2009)
17. Sorathia, V., van Sinderen, M., Ferreira Pires, L.: Towards a Unifying Process Framework for Services Knowledge Management. In: Morin, J.-H., Ralyté, J., Snene, M. (eds.) IESS 2010. LNBIP, vol. 53, pp. 295–299. Springer, Heidelberg (2010)

18. Spohrer, J., Gregory, M., Ren, G.: The Cambridge-IBM SSME White Paper Revisited. In: Handbook of Service Science. Service Science: Research and Innovations in the Service Economy, pp. 677–706. Springer, Heidelberg (2010)
19. Spohrer, J., Maglio, P.P.: Toward a Science of Service Systems Value and Symbols. In: Handbook of Service Science. Service Science: Research and Innovations in the Service Economy, pp. 157–194. Springer, Heidelberg (2010)
20. Stanicek, Z., Winkler, M.: Service Systems through the Prism of Conceptual Modeling. Service Science 2(1/2), 112–125 (2010)
21. Vargo, S.L., Lusch, R.F.: Evolving to a new dominant logic for marketing. J. of Marketing 68(1), 1–17 (2004)
22. Vargo, S.L., Lusch, R.F.: Service-dominant logic: reactions, reflections and refinements. Marketing Theory 6(3), 281–288 (2006)
23. Vargo, S.L., Lusch, R.F.: Service-dominant logic: continuing the evolution. J. of the Academy of Marketing Science 36(1), 1–10 (2008)
24. Vargo, S.L.: Customer Integration and Value Creation: Paradigmatic Traps and Perspectives. Journal of Service Research 11(2), 211–215 (2008)
25. Vargo, S.L.: Toward a transcending conceptualization of relationship: a service-dominant logic perspective. Journal of Business & Industrial Marketing 24(5/6), 373–379 (2009)
26. Vargo, S.L., Akaka, M.A.: Service-Dominant Logic as a Foundation for Service Science: Clarifications. Service Science 1(1), 32–41 (2009)
27. Vargo, S.L., Lusch, R.F., Wessels, G.: Toward a conceptual foundation for service science: Contributions from service-dominant logic. IBM Systems Journal 47(1), 5–14 (2008)
28. Vargo, S.L., Lusch, R.F., Akaka, M.A.: Advancing Service Science with Service-Dominant Logic: Clarifications and Conceptual Development. In: Handbook of Service Science. Service Science: Research and Innovations in the Service Economy, pp. 133–156. Springer, Heidelberg (2010)
29. Weigand, H.M., Johannesson, P., Andersson, B., Bergholtz, M.: Value-Based Service Modeling and Design: Toward a Unified View of Services. In: van Eck, P., Gordijn, J., Wieringa, R. (eds.) CAiSE 2009. LNCS, vol. 5565, pp. 410–424. Springer, Heidelberg (2009)